

Appl. No. : 10/807,528
Filed : March 23, 2004

AMENDMENTS TO THE CLAIMS

Please amend the Claim Form and Claim as follows. Insertions are shown underlined while deletions are ~~struck-through~~. Please add claim 28.

1 (original): A plasma treatment apparatus for thin-film deposition comprising:

a reactor chamber;

a pair of parallel-plate electrodes disposed inside the chamber, between which a thin film is to be formed on a substrate; and

a radio-frequency power supply system used for transmitting radio-frequency power to one of the parallel-plate electrodes via multiple supply points provided on the one of the parallel-plate electrodes,

said radio-frequency power supply system comprises:

a radio-frequency power source; and

a radio-frequency transmission unit for transmitting radio-frequency power from the radio-frequency power source to the multiple supply points of the one of the parallel-plate electrodes,

said radio-frequency transmission unit comprising:

an inlet transmission path and multiple branches branched off from the inlet transmission path, wherein each branch connected to the supply point of the parallel-electrode is multiple branchings downstream of the inlet transmission path and has a substantially equal characteristic impedance value; and

at least one inductance adjuster which is removably installed in at least one branch to render substantially equal the characteristic impedance value of each branch connected to the multiple supply points.

2 (original): The plasma treatment apparatus according to Claim 1, wherein the radio-frequency power supply system further comprises an impedance matching circuit between the radio-frequency power source and the radio-frequency transmission unit.

3 (original): The plasma treatment apparatus according to Claim 1, wherein each branch connected to the multiple supply point is two branchings downstream of the inlet transmission path, and four branches are connected to the multiple supply points.

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4 (original): The plasma treatment apparatus according to Claim 1, wherein each branch connected to the multiple supply point is provided with at least one inductance adjuster.

5 (original): The plasma treatment apparatus according to Claim 1, wherein all branches are provided with at least one inductance adjuster.

6 (original): The plasma treatment apparatus according to Claim 1, wherein the inductance adjuster is a ferrite core.

7 (original): The plasma treatment apparatus according to Claim 1, wherein the radio-frequency power transmission unit comprises a metal plate and inductors having substantially equal impedance values.

8 (currently amended): The plasma treatment apparatus according to Claim 6, wherein the radio-frequency power transmission unit comprises a metal plate and inductors having substantially equal impedance values, each inductor comprising a hollow copper tube, and the ferrite core has a circular-ring shape which can be inserted/attached into the hollow copper tube to adjust an impedance value of the transmission system by selecting the number of ferrite cores to be inserted/attached.

9 (original): The plasma treatment apparatus according to Claim 1, wherein the radio-frequency power has a frequency of about 27.12 MHz or higher.

10 (original): The plasma treatment apparatus according to Claim 1, wherein the supply points comprise supply terminals which are disposed on a surface of the one of the electrodes in rotationally symmetrical positions with respect to the center of the surface.

11 (original): The plasma treatment apparatus according to Claim 7, wherein the inductors comprise hollow copper tubes.

12 (original): The plasma treatment apparatus according to Claim 1, wherein the radio-frequency power source is a first radio-frequency power source and the supply system further comprises a second radio-frequency power source emitting power which has a different frequency from that of the power emitted from the first radio-frequency power source, and which is overlaid on the power emitted from the first radio-frequency power.

13 (original): The plasma treatment apparatus according to Claim 12, wherein the second radio-frequency power has a frequency of about 1 MHz or less.

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14 (original): The plasma treatment apparatus according to Claim 2, wherein the impedance matching circuit is connected to the radio-frequency transmission unit by a co-axial cable.

15 (original): A plasma treatment apparatus for thin-film deposition comprising:

a reactor chamber;

a pair of parallel-plate electrodes disposed inside the chamber, between which a thin film is to be formed on a substrate; and

a radio-frequency power supply system used for transmitting radio-frequency power to one of the parallel-plate electrodes via multiple supply points provided on the one of the parallel-electrodes,

said radio-frequency power supply system comprises:

a radio-frequency power source;

an impedance matching circuit; and

a radio-frequency transmission unit for transmitting radio-frequency power from the radio-frequency power source to the multiple supply points of the one of the parallel-plate electrodes via the impedance matching circuit,

said radio-frequency transmission unit comprising:

an inlet transmission path and multiple branches branched off from the inlet transmission path, wherein the inlet transmission path branches into two secondary branches, each secondary branch branching into two tertiary branches, each tertiary branch being connected to the supply point and having a substantially equal characteristic impedance value; and

at least one inductance adjuster which is removably installed in at least one branch to render substantially equal the characteristic impedance value of each branch connected to the multiple supply points.

16 (original): A radio-frequency transmission unit configured to connect a radio-frequency power source and a reaction chamber of a plasma treatment apparatus for thin-film deposition, comprising:

an inlet transmission path and multiple branches branched off from the inlet transmission path, wherein branches configured to be connected to one of two parallel-

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plate electrodes provided in the reaction chamber are multiple branchings downstream of the inlet transmission path and have a substantially equal characteristic impedance value, wherein the branches which are multiple branchings downstream of the inlet transmission path are symmetrically disposed with respect to a center of the one of the electrodes; and

at least one inductance adjuster which is removably installed in at least one branch to render substantially equal the characteristic impedance value of each branch connected to the multiple supply points.

17 (original): The radio-frequency transmission unit according to Claim 16, which is connected to an impedance matching circuit via a coaxial cable.

18 (withdrawn): A method for forming a carbon-containing silicon oxide film on a semiconductor substrate using the plasma treatment apparatus as claimed in Claim 1, which comprises:

determining the number of the at least one inductance adjuster to adjust characteristic impedance of each branch connected to the supply point to be equal to each other;

heating the semiconductor substrate up to a given temperature;

introducing a reaction gas into the reaction chamber;

controlling a pressure inside the reaction chamber at a given value; and

applying radio-frequency power from the radio-frequency power source to one of the electrodes via the radio-frequency transmission unit, thereby forming a carbon-containing silicon oxide film on the semiconductor substrate.

19 (withdrawn): The method according to Claim 18, wherein the reaction gas contains an alkoxysilicon compound and an inert gas.

20 (withdrawn): The method according to Claim 18, wherein the reaction gas contains an alkoxysilicon compound, an oxygen-containing gas, and an inert gas.

21 (withdrawn): The method according to Claim 18, wherein the reaction gas contains an alkylsilicon compound, ammonia and an inert gas.

22 (withdrawn): The method according to Claim 18, wherein the reaction gas contains an alkylsilicon compound, an oxygen-containing gas, and an inert gas.

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23 (withdrawn): The method according to Claim 18, wherein the inductance adjuster is a ferrite core.

24 (withdrawn): The method according to Claim 18, wherein the radio-frequency power has a frequency of 27.12 MHz or higher.

25 (withdrawn): The method according to Claim 18, wherein the radio-frequency power is introduced to the radio-frequency transmission unit via an impedance matching circuit.

26 (withdrawn): The method according to Claim 18, wherein the non-uniformity in film thickness is $\pm 3\%$ or less.

27 (withdrawn): The method according to Claim 18, wherein the semiconductor substrate has a diameter of 300 mm.

28 (new): The plasma treatment apparatus according to Claim 10, wherein the supply terminals are disposed in the vicinity of an outer periphery of the electrode.